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Forest Insect And Disease Management

BIOLOGICAL EVALUATION R10-78-1

BIRCH LEAF ROLLERS
ANCHORAGE BOWL

Chugach National Forest
and Adjacent Lands

November 1978

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U.S. Department of Agriculture
State and Private Forestry

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Alaska Region

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INTRODUCTION:

Recently leaf roller activity has become apparent on paper birch (Betula papyrifera Marsh.) in southcentral Alaska. In 1976 5700 hectares of paper birch were affected in the vicinity of Anchorage, Eagle River, Palmer and portions of the northern Kenai Peninsula. Up to 100 percent defoliation occurred in many stands (Rush et.al. 1977).

During the spring and summer of 1977 leaf roller activity in these same areas increased to an estimated 21,042 hectares (Yarger et.al. 1978). This increase in defoliation was readily apparent in urban areas where paper birch is the most commonly encountered residential, park and green-belt tree.

Little is known concerning the identification, biology and impact of these leaf rollers. Two genera have been tentatively identified (Epinotia spp. and Archips spp.)(Olethreutinae); however, the species remain unidentified (Rush et. al. 1977). Accordingly, it was felt that leaf roller biology and impact evaluation studies should be undertaken in order to effectively assess the impact of this urban and forest defoliator. Such improvements in the base-line information will greatly increase our knowledge of problematic Alaska forest insects and our expertise in managing these insects.

OBJECTIVES:

It is believed that a more complete knowledge of birch leaf rollers will yield valuable insights into possible suppression measures. Accordingly, the principal objective of this study is an indepth investigation concerning leaf roller identification, biology and sampling regimes. For these purposes we plan:

1. To identify the leaf roller species(s) involved.

2. To identify the life cycle and life stages of the leaf roller species.

3. To predict, based on the results of this study, next year's population levels.

4. To determine what studies and information are needed for an assessment of leaf roller impact on the host tree vigor.

Close coordination with the Institute of Northern Forestry and the Canadian Forestry Service in various phases of this study will ensure that all objectives are met.

MATERIALS AND METHODS:

A. STUDY AREAS

In the winter of 1977-78 two paper birch stands near Anchorage were selected as evaluation plots. Each plot consisted of 30 randomly selected paper birch. Each tree was tagged at breast height. These plots are located on the Bureau of Land Management administered Campbell Creek tract. Plot #1 is approximately 480' a.s.l. (1/) and is almost totally paper birch. The mean height and diameter of Plot #1 trees are 40' and 5.5" respectively, with an average age of 34 years. Plot #2 at 280' a.s.l. contained the following mixture of species: 30 percent paper birch, 69 percent quaking aspen (*Populus tremuloides* Michx.) and 1 percent white spruce (*Picea glauca* [Moench] Voss) understory. The 30 paper birch in this plot were approximately 25' tall with a mean diameter at breast height of 4.0"; average age is 16 years.

B. CLIMATIC CONDITIONS

Due to a lack of weather recording instruments, only one weather station was placed in Plot #2. A Belfort hygrothermograph was housed in a standard, white, louvered weather station, approximately 2m above the ground. Temperature and relative humidity were recorded hourly. Climatic data will be related to leaf roller development and attack intensity.

C. LEAF ROLLER IDENTIFICATION AND BIOLOGY

Previous studies on hardwood leaf rollers have indicated no differences in defoliator densities as related to crown position (Werner Pers. Com. 1978). However, there was a tendency for higher leaf roller densities in the lower-crown region. Accordingly, branch samples were taken from the lower-crown from five randomly selected tagged trees within each study area at weekly intervals. The first 25 buds or leaves per branch were examined for eggs, larvae or pupae; this is similar to the sampling method used by Henson (1954). Likewise, approximately 150 larvae from each study plot were collected weekly. Head capsule widths from 75 larvae were measured to the nearest hundredth millimeter for instar determination. The remaining 75 larvae were placed in laboratory rearing cages (five larvae per cage) provided with host foliage.

Pupae and emerging adults from the rearings were measured and secondary sex characteristics of both were determined. Associated parasites were likewise collected.

1/ a.s.l. = above sea level

RESULTS AND DISCUSSION:

Throughout the summer a complex of leaf rollers was noted on birch. However, it quickly became apparent that 99 percent of the damage and the majority of the insects were one species. Accordingly, emphasis was placed on this one species. However, identifications are being undertaken on other associated leaf rollers. The major leaf roller on paper birch was identified as Epinotia solandriana L. This insect is a common leaf roller of birch from Newfoundland to British Columbia, the State of Washington and Europe (Lindquist and Macleod, 1967). However, this is the first time this species has been identified from Alaska.

A. LIFE STAGES:

Adult: The adult E. solandriana is a small moth measuring 0.74cm in length, with an average alar expanse of 1.90cm. A wide variety of forewing pattern was observed confirming the findings of Lindquist and Macleod (1967). Moths of type A, subdued greys and browns, are the most common, accounting for 78 percent of the specimens reared. Sexual characteristics of adults are easily discernible in the field without magnification. Slight pressure on the last visible abdominal segments of both sexes reveals the retracted genital segments. In the male the retracted genitalia form a pair of claspers covered with hairlike scales. In the female the ovipositor valvulae can easily be seen and is not covered with fine scales (Werner 1976).

Egg: The egg is oval to eliptical in shape, measuring 0.99mm long and 0.78mm wide; the egg surface is ridged . Recently deposited eggs are red-orange, changing with age to reddish brown.

Larvae: The first-instar larvae is pale cream with a dark grey-brown head. Second, third and fourth instar larvae become grey, retaining the darkish head. Prior to pupation, larval coloration resembles that of first instar larvae. Mean head widths of the four instars are shown in Table 1. Detailed larval descriptions are provided by Lindquist and Macleod (1967).

Table 1. Head Capsule Widths of Epinotia solandriana L. Larvae

Larval Instar	Numbers Measured	Mean Head Width (mm)	S.D.
I	167	0.37	0.21
II	129	0.55	0.05
III	133	0.82	0.08
IV	198	1.21	0.13

Pupae: Newly-formed pupae are pale yellow, darkening with age to reddish brown. Thirty pupae (15 male and 15 females) were measured and the following information recorded. Mean length and width for males are 7.99mm (s.d. 0.53) and 2.20mm (s.d. 0.15) respectively; mean length and width for females are 8.26mm (s.d. 0.55) and 2.24mm (s.d. 0.14) respectively.

Pupal sexual characteristics can be distinguished only under a microscope and are confined to the terminal abdominal segments (Butt and Cantu 1962). The main difference between the sexes is the location of the genital pore. In female pupae the genital pore occurs ventrally on the eighth abdominal segment, whereas on the male it occurs ventrally on the ninth. The sexes are indistinguishable on the dorsal side.

B. LIFE HISTORY:

The life history of *E. solandriana* in southcentral Alaska is similar to that reported in Ontario, Canada by Lindquist and Macleod (1967). Preferred host in Alaska is paper birch; however, quaking aspen, black cottonwood (*Populus trichocarpa* Torr and Gray), balsam poplar (*P. balsamifera* L) and alder (Alnus spp.) are attacked. The seasonal development of *E. solandriana* is presented in Fig. 1.

E. solandriana is univoltine in Alaska, overwintering in the egg stage. Eggs are laid singly on roughened bud stalks or previous years' twigs. Eggs began to hatch in the field plots around the first of May and terminated 10 days later. Under laboratory conditions 75 percent of the eggs hatched within 8 days; 25 percent failed to hatch. Recently emerged larvae begin webbing and feeding on expanding young leaves. For the first two weeks the larvae web the leaves together and feed within; little leaf rolling is evident. However, by the first week in June, webbing of leaves is discontinued and leaf rolling is quite evident. Ninety-six percent of rolled leaves have one larvae per leaf roll; the remaining 4 percent contain two or more larvae. Ninety percent of the leaf rolls are vacated by mid-June. Full grown larvae fall to the ground and pupate between the humus layer and the mineral soil. The average duration of the pupal stage under laboratory conditons for females was 19.05 days (s.d. 1.98, n = 17) and for males, 18.96 days (s.d. 1.83, n = 27). Of 72 laboratory reared pupae, 61 percent emerged, 4 percent were parasitized, and 35 percent failed to emerge (mostly due to molding).

The duration of the pupal stage under laboratory and field conditions differed by more than two weeks. The delay in pupal development was probably related to climatic conditions (Figs. 2 and 3). Average daily 1978 temperatures were below the 1976-1977 averages and precipitation was substantially higher from mid-June to mid-July, the time of pupal development. However, below average temperatures rather than high precipitation probably had more of an effect on pupation. Pupae normally require moist conditions.

Adults were first collected around the first week of August from ground vegetation and birch stems. Eggs were observed on roughened birch bud stalks by mid-August, reaching a peak by the first week of September.

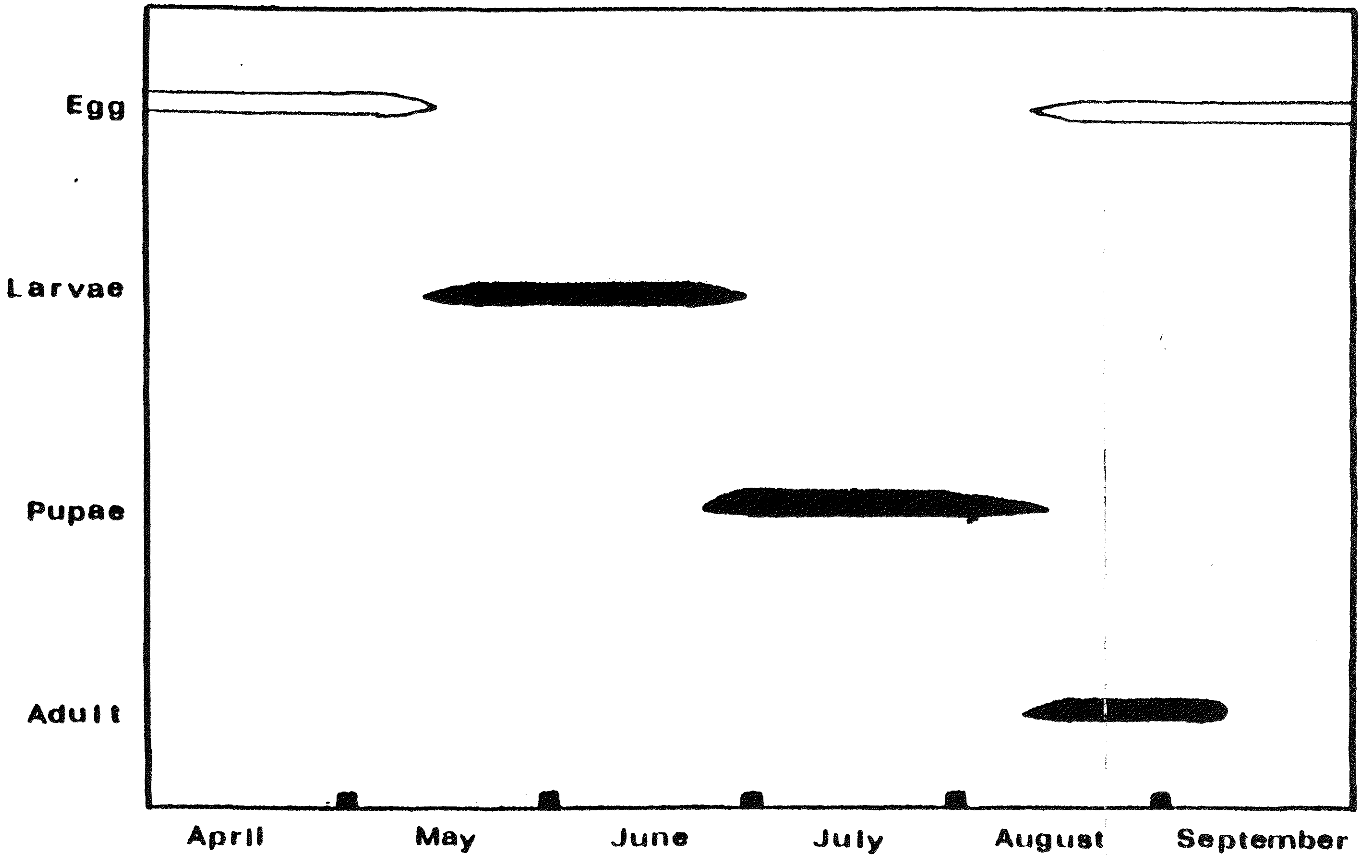


Fig. 1 Generalized seasonal development of Epinotia solandriana L. in southcentral Alaska. The blank portion represents the over-wintering egg stage.

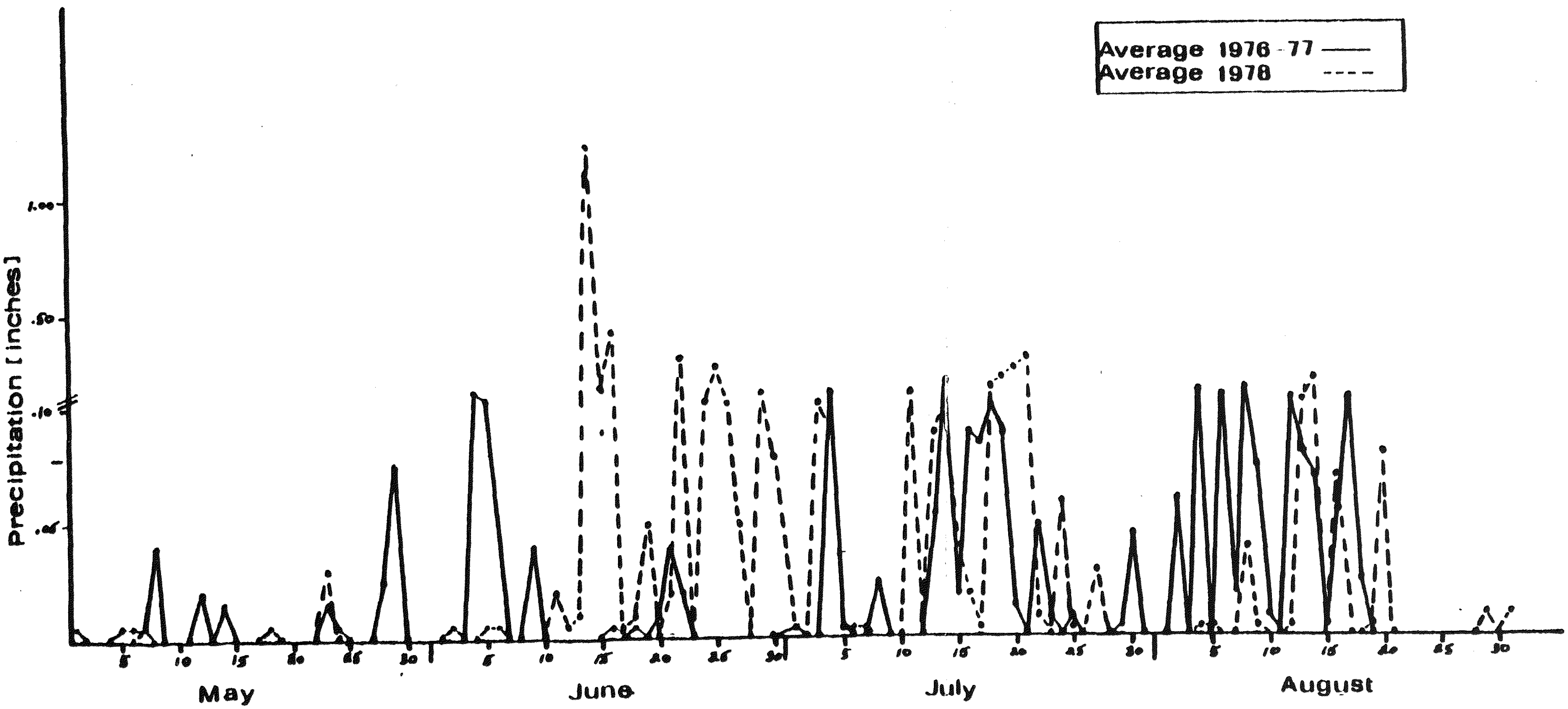
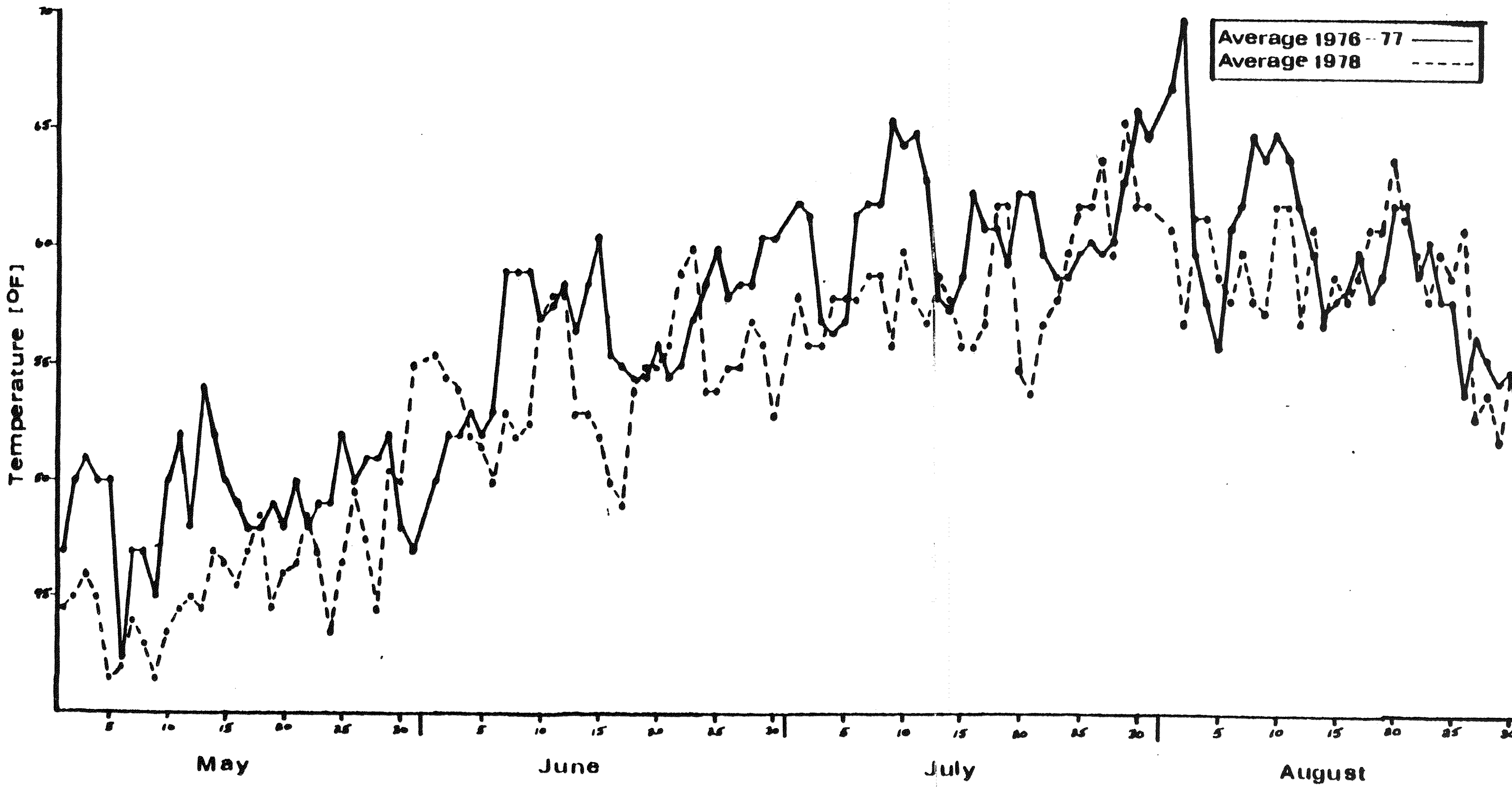


Fig.2 Anchorage precipitation by month


Average 1976 - 77
Average 1978
Temperature [°F]
70
65
60
55
50
45
5
10
15
20
25
30
May
June
July
August

C. 1979 LEAF ROLLER POPULATIONS:

The easiest method to forecast leaf roller numbers for the coming season is by taking egg counts from the first 25 buds from lower branches on randomly chosen trees. Leaf roller eggs are easily counted and can be undertaken any time from September to the first of May. Our Fall 1978 plot samples indicated 8 eggs/plot/5 sample branches vs. 11 eggs/plot/5 sample branches taken in the Spring of 1978; thus, 1979 populations should be numerically similar to 1978.

On the other hand, it is difficult to predict what levels of damage will occur in 1979. Little leaf roller damage was detected aerially this year even though ground checks confirmed active leaf rolling. It appears that weather helped suppress leaf roller activity. Parasitism had very little effect as less than one and four percent of laboratory larval and pupal rearings, respectively, were parasitized (Braconidae). However, scattered birch mortality was quite evident in the Anchorage bowl. Undoubtedly this was a result of 3 - 4 consecutive years of heavy to moderate leaf roller activity.

Based upon the above observations, 1979 leaf roller populations will remain the same as 1978. If 1979 summer weather follows that of 1978, we can expect moderate leaf rolling with scattered branch dieback and tree mortality. However, if summer weather returns to normal, leaf roller damage may be much more evident and wide-spread.

D. CONTROL ALTERNATIVES:

For the most part leaf roller suppression is not warranted on forested land. Leaf rollers are a natural occurrence in Alaska and cause very little permanent damage to the host tree species involved. Periodic population increases can cause limited branch dieback, a temporary reduction in growth, and rarely, tree mortality. However, under urban conditions, leaf rollers can become much more devastating to host tree vigor and aesthetically devastating as well.

Accordingly the following control alternatives apply to urban settings.

Alternative 1: Doing nothing to alleviate the pressure of leaf roller attack on paper birch is an option and, in many cases, a viable one. If birch trees are cared for (fertilization 1/, minimization of soil compaction, etc.) leaf roller damage to host tree vigor is mininal; at worst, resulting in limited branch dieback and temporary growth reduction.

1/2 - 3 lbs of fertilizer per one inch of base diameter should be placed around the dripline for adequate root feeding. Fertilization should begin in Spring and be carried out through the growing season.

Alternative 2: Direct control by chemical treatment of infested trees is viable in many circumstances. If birch have shown past signs of heavy leaf rolling for two consecutive years and branch dieback is apparent, chemical treatment may be warranted. Of utmost importance is the timing of pesticide applications. Many sprays are applied when leaf-rolling is apparent. Unfortunately, many of these applications are ineffectual as full grown larvae have left their protective leaf rolls and are pupating in the humus layer. To be effective pesticides should be applied during the latter part of May when young larvae are webbing leaves together. At this stage the larvae are quite susceptible.

There are a number of insecticides containing Malathion® and Carbaryl® registered by the E.P.A. for leaf roller suppression. When using insecticides the entire label should be read carefully and all safety precautions should be followed.

E. RECOMMENDATIONS:

Both alternatives are viable to the home-owner. The choice of one or the other depends on the value of the tree, the health of the tree, the history of infestation and the degree of damage inflicted upon the host trees by past leaf roller populations.

F. CONCLUSIONS:

The results of the 1978 leaf roller study have provided us with adequate base-line information concerning leaf roller identification, life history and the sampling of over-wintering eggs as a predictive measure for forthcoming populations. The above cooperative studies will be continued throughout 1979 with emphasis placed on: the effects of climate on leaf roller populations; the effect of parasitism and predation; and the identification and life histories of associated leaf rollers.

Likewise, evaluations will be initiated with respect to (1) impact of leaf roller defoliation on host tree vigor, and (2) determination of defoliation threshold levels resulting in human concern. The determination of leaf roller impact and socio-economic considerations will allow us to more effectively evaluate the benefits of leaf roller suppression tactics.

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